2003 Conference on Selective Catalytic Reduction (SCR) and Selective Non-Catalytic Reduction (SNCR) for NOx Control

Control Systems for Long Term Field Testing Applications

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Reaction Engineering is making use of state-of-the-art hardware and software technologies to develop control systems for use in long term field testing applications. The systems are designed to provide significant autonomy to eliminate the need for onsite personnel during long duration tests. This high level of autonomy is accomplished with a combination of robust, real-time embedded controllers and the ability to easily monitor and configure the systems remotely using a standard web browser.

Within elements of the control systems themselves, wireless technologies are often deployed to allow access and control to test locations which are difficult or impossible to reach with standard copper or fiber optic cabling. These wireless links are often difficult in the harsh industrial environments of power plants and typically require high power radios with directional antennas to ensure reliable connectivity.

In all cases, special attention is given to computer network security to ensure that neither the control system nor the host plant's network is put at risk. This is especially important when utilizing difficult-to-secure protocols such as 802.11-based wireless Ethernet. Technologies employed include VPN, firewalls and proprietary forms of WEP.

The following paragraphs describe two long term field tests which are currently in progress and which make use of the aforementioned control system hardware and software.

SCR Catalyst Deactivation Test Reactor

SCR is widely used in the electric power industry for reduction of nitrogen oxides. Because of this technology's important role in reducing air pollution from power generation, a detailed understanding of the mechanisms affecting catalyst deactivation is vital. To address these research issues, the University of Utah and Reaction Engineering have developed a catalyst test reactor to evaluate vanadium-based catalysts and to monitor their deactivation during exposure to flue gas from a power plant burning Powder River Basin coal.

The SCR catalyst test system is part of a project aimed at identifying catalyst deactivation mechanisms in power plants burning sub-bituminous coals or biomass. The test system is designed to pull a slip stream of flue gas from a boiler, run that through SCR catalyst chambers and return the flue gas to the boiler duct. Six different catalysts are being tested in parallel, and will be exposed for up to six months. Deactivation is being tested both with online measurements of NOx reduction and by periodically taking catalyst samples and evaluating these in a laboratory.

The slipstream reactor is currently operating at a large utility coal-fired boiler. The control system is being accessed for remote control and monitoring of the reactor from REI's offices in Salt Lake City. The control system maintains desired flow rates through each catalyst chamber, controls reactor temperature, interfaces with the gas analysis equipment, sets the required flow rate of ammonia reagent and logs all data to a database.

Real-Time Corrosion Monitoring System

REI, in collaboration with Corrosion Management (Manchester, UK), has developed and tested an advanced corrosion monitoring technology for application to high temperature combustion environments. This technology provides immediate response, high sensitivity, and quantitative corrosion measurements over a range of conditions.

The need for effective corrosion monitoring and management has increased with the recent wide-spread adoption of low-NOx firing systems for cost-effective control of NOx emissions. The resulting reducing conditions and flame impingement on waterwalls have sometimes led to unacceptable corrosion and/or limitations on the extent of potential reductions of NOx emissions. The ability to understand, monitor, and manage boiler waterwall loss can be dramatically improved through the application of a verifiable, real-time corrosion monitoring system.

Applications of this technology in laboratory combustors, pilot-scale facilities and during field tests at coal-fired utility boilers have established its value as a tool for addressing high temperature corrosion. The equipment has proven durable, flexible, and can be operated remotely or as an on-site addition to existing instrumentation operations. In addition, a proprietary technique has been developed that allows the sensor elements to be removed periodically to verify the quantitative accuracy of the sensor.

REI currently has a system of six corrosion monitoring sensors installed in a large utility coal-fired boiler. Inconveniently located probes communicate wirelessly back to a central data storage site. The control system deployed with the probes controls their temperature, allows remote access to monitor corrosion rates and logs all incoming data to a database. The control system also interfaces directly with the plant’s control system so that corrosion information can be displayed directly to the plant operators in the control room and used to help make operational decisions.